

IN THE CLAIMS

The following is a complete listing of the claims, and replaces all earlier versions and listings.

1. - 29. (Canceled)

30. (Currently Amended) A method of forming a sequence of images for transmission over a communication network, said method comprising the steps of:
forming representations of plural graphical object-based images;
rendering the images in a sequence using a computer graphics application, the rendering comprising:
determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and
indicating the changes in a format known to an encoder *a priori*;
encoding the sequence using said encoder such that the encoder utilizes at least one of the changes to optimize encoding of the current image; and
storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence.
A method according to claim 29; wherein said encoded representation comprises a plurality of separately encoded discrete portions, and
wherein the set of changes comprises a change to a compositing tree by which the object-based graphical image is described, the change indicating a portion of

a rendered current image having changed, said encoding comprising determining the discrete portions that require update as a result of the change, encoding rendered pixel values output from the computer graphics application corresponding to the changes as replacement ones of the portions, and combining the replacement portions with remaining portions of the preceding encoded image to form a current encoded image.

31. - 35. (Canceled)

36. (Currently Amended) A method of forming a sequence of images for transmission over a communication network, said method comprising the steps of:
forming representations of plural graphical object-based images;
rendering the images in a sequence using a computer graphics application, the rendering comprising:
determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and
indicating the changes in a format known to an encoder *a priori*;
encoding the sequence using said encoder such that the encoder utilizes at least one of the changes to optimize encoding of the current image; and
storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,
wherein said encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A method according to claim 35, wherein said encoding forms an MPEG P-frame, the encoding further comprising:

- (a) extracting a slice of a rendered image frame, the slice comprising a plurality of the macroblocks;
- (b) determining if a first macroblock of the extracted slice is dirty and, if so, encoding the first macroblock to an output bitstream and storing a copy of the encoded first macroblock in a cache and, if not, copying a pre-encoded macroblock from the cache to the output bitstream;
- (c) for each further macroblock in the slice barring the last, determining if the macroblock is dirty and, if so:
 - (ca) encoding the macroblock to the output bitstream, and
 - (cb) storing the encoded macroblock in said cache;
- (d) for the last macroblock in the slice:
 - (da) determining if the macroblock is dirty,
 - (db) if so, encoding the last macroblock to the output bitstream, and
 - (dc) if not, copying a pre-encoded macroblock from said cache to the output bitstream; and
- (e) repeating steps (a) to (d) for each remaining slice of the rendered image frame to thereby form the P-frame.

37. (Currently Amended) A method of forming a sequence of images for transmission over a communication network, said method comprising the steps of:

forming representations of plural graphical object-based images;

rendering the images in a sequence using a computer graphics application, the rendering comprising:

determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

indicating the changes in a format known to an encoder *a priori*

encoding the sequence using said encoder such that the encoder utilizes at least one of the changes to optimize encoding of the current image; and

storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein said encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A method according to claim 35, wherein said encoding forms an MPEG I-frame, said encoding further comprising:

(a) obtaining a macroblock of a rendered image frame;

(b) extracting an unencoded DC value of the previous macroblock from a cache used to store encoded frames;

(c) determining a difference DC value between the obtained macroblock and the extracted unencoded DC value;

(d) encoding the difference DC value to an output bitstream;

(e) copying an encoded AC component from the cache to the output bitstream; and

(f) repeating steps (a) to (e) for each macroblock of the rendered image frame to form the I-frame.

38. (Currently Amended) A method of forming a sequence of images for transmission over a communication network, said method comprising the steps of:

forming representations of plural graphical object-based images;

rendering the images in a sequence using a computer graphics application, the rendering comprising:

determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

indicating the changes in a format known to an encoder *a priori*;

encoding the sequence using said encoder such that the encoder utilizes at least one of the changes to optimize encoding of the current image; and

storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein said encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A method according to claim 35, wherein said encoding further comprises setting a flag on any macroblock that has previously been marked as dirty and subsequently encoded and upon any previous macroblock that has the flag set, the flag being used to determine whether one of cached bitstream representation of the macroblock or a stored encoded bitstream of the macroblock is restored to an output bitstream.

39. (Currently Amended) A method of forming a sequence of images for transmission over a communication network, said method comprising the steps of:
forming representations of plural graphical object-based images;
rendering the images in a sequence using a computer graphics application, the rendering comprising:
determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and
indicating the changes in a format known to an encoder *a priori*;
encoding the sequence using said encoder such that the encoder utilizes at least one of the changes to optimize encoding of the current image; and
storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,
wherein said encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A method according to claim 35, wherein said encoding comprises,
for each macroblock:

- (a) storing a DC component for the macroblock;
- (b) storing a reference from the macroblock to an immediately preceding macroblock;
- (c) DCT transforming, quantizing and storing an AC component of the macroblock; and
- (d) storing a flag to mark the macroblock as either dirty or non-dirty.

40. (Previously Presented) A method according to claim 39, further comprising, for each macroblock that is marked as dirty, the steps of:

- (i) applying a DCT;
- (ii) calculating and saving the DC delta ;
- (iii) quantizing the macroblock;
- (iv) saving the DC component of the macroblock;
- (v) encoding the macroblock using bit stream encoding;
- (vi) saving the bitstream encoded macroblock; and
- (vii) setting the dirty flag to not dirty.

41. (Previously Presented) A method according to claim 39, further comprising, for each macroblock that is marked as non-dirty, and is not preceded by dirty macroblocks since the start of a current slice, restoring the macroblock from a bitstream encoded version thereof.

42. (Previously Presented) A method according to claim 39, further comprising, for each macroblock that is not marked as dirty, but preceded by a macroblock marked as dirty since the start of a current slice, the steps of:

- (i) restoring the cached DC values;
- (ii) calculating the DC delta;
- (iii) quantizing the DC portion of the macroblock;
- (iv) encoding the macroblock using bit stream encoding; and
- (v) saving the bitstream encoded macroblock.

43. - 56. (Canceled)

57. (Currently Amended) A computer readable medium having recorded thereon a computer program for forming a sequence of images for transmission over a communication network, the program comprising:

code for forming representations of plural graphical object-based images;

code for rendering the images in a sequence using a computer graphics application, the code for rendering including:

code for determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

code for indicating the changes in a format known to an encoder *a priori*;

code for encoding the sequence using said encoder such that said encoder utilizes at least one of the changes to optimize encoding of the current image; and

code for storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein the encoded representation comprises a plurality of separately encoded discrete portions, and

~~A computer readable medium according to claim 56, wherein the set of changes comprises a change to a compositing tree by which the object-based graphical image is described, the change indicating a portion of a rendered current image having changed, said code for encoding comprising code for determining the discrete portions that require update as a result of the change, code for encoding rendered pixel values output from the computer graphics application corresponding to the changes as replacement ones of the portions, and code for combining the replacement portions with remaining portions of the preceding encoded image to form a current encoded image.~~

58. - 62. (Canceled)

63. (Currently Amended) A computer readable medium having recorded thereon a computer program for forming a sequence of images for transmission over a communication network, the program comprising:

code for forming representations of plural graphical object-based images;

code for rendering the images in a sequence using a computer graphics application, the code for rendering including:

code for determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

code for indicating the changes in a format known to an encoder *a priori*;

code for encoding the sequence using said encoder such that said encoder utilizes at least one of the changes to optimize encoding of the current image; and

code for storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein the encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A computer readable medium according to claim 62, wherein said encoding forms an MPEG P-frame, said code for encoding further comprising being executable to perform the steps of:

- (a) extracting a slice of a rendered image frame, the slice comprising a plurality of the macroblocks;
- (b) determining if a first macroblock of the extracted slice is dirty and, if so, encoding the first macroblock to an output bitstream and storing a copy of the encoded first macroblock in a cache and, if not, copying a pre-encoded macroblock from the cache to the output bitstream;
- (c) for each further macroblock in the slice barring the last, determining if the macroblock is dirty and, if so:
 - (ca) encoding the macroblock to the output bitstream, and
 - (cb) storing the encoded macroblock in said cache;
- (d) for the last macroblock in the slice:
 - (da) determining if the macroblock is dirty,
 - (db) if so, encoding the last macroblock to the output bitstream, and
 - (dc) if not, copying a pre-encoded macroblock from the cache to the output bitstream; and
- (e) repeating steps (a) to (d) for each remaining slice of the rendered image frame to thereby form the P-frame.

64. (Currently Amended) A computer readable medium having recorded thereon a computer program for forming a sequence of images for transmission over a communication network, the program comprising:

code for forming representations of plural graphical object-based images;

code for rendering the images in a sequence using a computer graphics application, the code for rendering including;

code for determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

code for indicating the changes in a format known to an encoder *a priori*;

code for encoding the sequence using said encoder such that said encoder utilizes at least one of the changes to optimize encoding of the current image; and

code for storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein the encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A computer readable medium according to claim 62, wherein said encoding forms an MPEG I-frame, the code for encoding further comprising being executable to perform the steps of:

- (a) obtaining a macroblock of a rendered image frame;
- (b) extracting an unencoded DC value of the previous macroblock from a cache used to store encoded frames;

(c) determining a difference DC value between the obtained macroblock and the extracted unencoded DC value;

(d) encoding the difference DC value to an output bitstream;

(e) copying an encoded AC component from the cache to the output bitstream; and

(f) repeating steps (a) to (e) for each macroblock of the rendered image frame to form the I-frame.

65. (Currently Amended) A computer readable medium having recorded thereon a computer program for forming a sequence of images for transmission over a communication network, the program comprising:

code for forming representations of plural graphical object-based images;

code for rendering the images in a sequence using a computer graphics application, the code for rendering including:

code for determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

code for indicating the changes in a format known to an encoder *a priori*;

code for encoding the sequence using said encoder such that said encoder utilizes at least one of the changes to optimize encoding of the current image; and

code for storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence.

wherein the encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

A computer readable medium according to claim 62, wherein said code for encoding further comprises being executable to set setting a flag on any macroblock that has previously been marked as dirty and subsequently encoded and upon any previous macroblock that has the flag set, the flag being used to determine whether one of cached bitstream representation of the macroblock or a stored encoded bitstream of the macroblock is restored to an output bitstream.

66. (Currently Amended) A computer readable medium having recorded thereon a computer program for forming a sequence of images for transmission over a communication network, the program comprising:

code for forming representations of plural graphical object-based images;

code for rendering the images in a sequence using a computer graphics application, the code for rendering including:

code for determining a set of changes required to transform a previous image in the sequence into a current image in the sequence, and

code for indicating the changes in a format known to an encoder *a priori*;

code for encoding the sequence using said encoder such that said encoder utilizes at least one of the changes to optimize encoding of the current image; and

code for storing an encoded representation of at least the current image for use in an encoding of a subsequent image in the sequence,

wherein the encoded representation comprises a plurality of separately encoded discrete portions,

said encoding forms an MPEG representation of each image in which the discrete portions comprise MPEG macroblocks, and

~~A computer readable medium according to claim 62, wherein said code for encoding comprises~~ is executable to perform, for each macroblock, the steps of:

- (a) storing a DC component for the macroblock;
- (b) storing a reference from the macroblock to an immediately preceding macroblock;
- (c) DCT transforming, quantizing and storing an AC component of the macroblock; and
- (d) storing a flag to mark the macroblock as either dirty or non-dirty.

67. (Currently Amended) A computer readable medium according to claim 66, further comprising, for each macroblock that is marked as dirty, code for performing the steps of:

- (i) applying a DCT;
- (ii) calculating and saving the DC delta ;

- (iii) quantizing the macroblock;
- (iv) saving the DC component of the macroblock;
- (v) encoding the macroblock using bit stream encoding;
- (vi) saving the bitstream encoded macroblock; and
- (vii) setting dirty flag to not dirty.

68. (Previously Presented) A computer readable medium according to claim 66, further comprising, for each macroblock that is marked as non-dirty, and is not preceded by dirty macroblocks since the start of a current slice, code for restoring the macroblock from a bitstream encoded version thereof.

69. (Currently Amended) A computer readable according to claim 66, further comprising, for each macroblock that is not marked as dirty, but preceded by a macroblock marked as dirty since the start of a current slice, code for performing the steps of:

- (i) restoring the cached DC values;
- (ii) calculating the DC delta;
- (iii) quantizing the DC portion of the macroblock;
- (iv) encoding the macroblock using bit stream encoding; and
- (v) saving the bitstream encoded macroblock.

70. - 80. (Canceled)